but if U is the wind velocity near the observer and V the wind velocity near the source of sound, the empirical formula

$$\nu_0 = \nu \frac{c - U + u}{c - V + v}$$

may be fairly accurate. It may be worth while to test this *formula experimentally*.

In the case of an overhead source of sound the theory is naturally complicated and is much more so when the variation of air density and wind velocity are taken into account. Experiments with sound produced in a moving aeroplane may indicate whether the above variations of atmospheric conditions with altitude have any appreciable effect on the observed frequency.

PROPAGATION TO GREAT DISTANCES OF THE SOUND OF CANNONADE AT THE FRONT.[1]

By G. BIGOURDAN.

[*Reprinted from* Science Abstracts, Sect. A, July 30, 1917, §657.]

A cannonade produces various noises from the mouths of the guns and from the explosions of the shells. Some of these noises can reach great distances, 200 to 300 kilometers, but it is not agreed how they reach them.

It is thus thought desirable to cite the case of an engineer, aged 52, totally deaf since the age of 6 through cerebrospinal meningitis. Placed at the side of a locomotive whistling, he perceived only a sudden pain of the drum skin, which ceased immediately in spite of the continuation of the whistling. For the last 20 years if within 1,000 to 1,500 meters of gunfire, he perceives two successive shocks—one transmitted by the earth, one by the air. The last affects the thorax particularly. At the commencement of the Somme offensive, from the outskirts of Paris, when attending [attentive?], he was conscious of vibration during the cannonade; sometimes he would perceive only dull blows, at others he would perceive something at the same instant as an ordinary hearer. The distance to the Somme front (120 kilometers) excluded entirely the route through the air, so it must be by the earth; and so also for the normal hearer, since both perceive it at the same time (see Science Abstracts, 1916, §1056).—*E. H. B[arton]*.

551.575 : 534 (048)

ACCOUSTIC EFFICIENCY OF FOG-SIGNAL MACHINERY.[2]

By L. V. KING.

[*Reprinted from* Science Abstracts, Sect. A, July 30, 1917, §655.]

The first section of this paper sketches the history of fog-signal experiments, dwelling specially on the work of Tyndall published in 1874 in a Trinity House report.

At about the same time experiments by Duane and by Joseph Henry were conducted, and were published in 1874. The result of fog-signal tests carried out in the United States to the year 1894 were published in Livermore's Report to the Lighthouse Board of that date.

In 1901 a committee of the Trinity House carried out, at the Isle of Wight, a series of tests under the scientific direction of Rayleigh and T. Matthews. For calm weather a low note (about 180 per second) was considered most suitable; when the wind was contrary and the sea rough, it was found that a higher note penetrated farther than a low one. The physical significance of this was discussed by Rayleigh at that time.[3] It appears surprising that while a blast is being sounded from a siren which can be heard about 8 miles away on a good day, energy is being expended at the rate of about 100 horsepower. The high note of a Scottish signal required 600 horsepower. Rayleigh *raised the question as to whether these enormous* powers are really utilized for the production of sound or whether from some cause, possibly avoidable, a large proportion may not be wasted.

The experience of French fog-signal engineers was summed up by C. Ribbière in 1908. This emphasized the desirability of obtaining further knowledge as to the efficiency of the fog-signal apparatus.

The second section deals with the production of sound by a special siren called the "diaphone," due in its present form to J. P. Northey. The essential feature of this apparatus is a hollow cylindrical piston, which is oscillated longitudinally by the "driving air," and so opens and closes ports which allow a series of puffs from the "sounding air." These puffs give a nearly pure tone of about 180 per second. This sound passes through a suitable horn.

The third section is occupied with the numerical relations between sound waves and their audibility as fog-signals.

The fourth section deals with the "phonometer" due to S. G. Webster. This consists of a Helmholtz hollow cylindrical resonating chamber, one end of which is pierced by a smooth hole communicating freely with the atmosphere, while the other has a very uniform plate of the best mica obtainable (such as is used in phonographs). The resonator is tuned to the pitch for which it is to be used as a detector, and the vibrations of the mica diaphragm are detected and measured as follows: The mica disk carries a sharp steel point firmly clamped at its center. A narrow steel strip is suitably held taut at both extremities in a fork capable of adjustment, and the strip has its center in contact with the steel point, so that a slight movement of the disk and point gives the strip a corresponding twist. This twist is detected by the movement of a beam of light reflected from a small concave mirror carried by the strip.

The diaphone may be worked backward and is then called the "phone" or standard generator. When its diaphragm is made to oscillate through a known amplitude it is possible to calculate the numerical characteristics of the spherical sound waves emitted. By the use of the "phone" and the "phonometer" the acoustic output of any sound generator of the same pitch (such as violin, cornet, or human voice) may be calculated.

Section five is on aerial sound waves of large amplitude and the discontinuity that may be expected to occur in their propagation. In the sixth section the thermodynamic estimate of acoustic efficiency is treated. By the use of resistance thermometers of iron wire one one-thousandth inch in diameter the temperature fall of the air, due to the conversion of the compressed air energy into sound, was measured in the diaphone.

Section seven deals with the actual fog-signal experiments carried out near Quebec in 1913. The acoustic efficiency of the diaphone in one case was found to be nearly 6 per cent, in another a little over 8 per cent. Using his phonometer A. G. Webster had previously found the violin, the cornet, and the human voice to have acoustic efficiencies of about 0.05 per cent, 0.1 per cent, and 1 per cent, respectively.

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[1] Comptes Rendus, Paris, Oct. 2, 1916, 163: 323-324.
[2] Jour., Franklin Inst., Philadelphia, Mar., 1917, 183: 259-286.
[3] Phil. Mag., 1903, 6: 289-305.

An eighth section deals with future problems in acoustic engineering. The paper is chiefly descriptive and includes many clear diagrams and other illustrations. Full details of the tests are to be published elsewhere shortly.—*E. H. B[arton]*.

SURFACE CURRENTS OF JUPITER.[4]

By S. BOLTON.

[*Reprinted from* Science Abstracts, Sect. A, Aug. 30, 1917, §743.]

A table is given showing details of phenomena observed on Jupiter during the apparition of 1916–17 with a 26-inch reflector, and a drawing indexed so that any feature can be readily recognized. The quickened rate of the equatorial current was quite abnormal, the period being 7.7 seconds shorter than during the last apparition (1915–16). The white and dark spots fringing the north edge of the north equatorial belt exhibited two separate rates of motion. With regard to the color of the planet the author confirms the observations of Lowell and Antoniadi on the cherry-red hue of the belts and poles.—*C. P. B[utler]*.

EFFECT OF TERRESTRIAL RELIEF ON IONIC DENSITIES IN THE ATMOSPHERE.[5]

By P. L. MERCANTON.

[*Reprinted from* Science Abstracts, Sect. A, July 30, 1917, §662.]

It is known that the ratio of positive to negative ionic charge densities is greater at elevated points on the earth's surface than at lower levels. The experiments here described were made at the Tour de Gourze, near Lausanne, which stands at the summit of a hill 930 meters above sealevel. The ionic charges were measured by means of an Ebert apparatus charged to 50—240 volts, which would thus catch only the more mobile ions. The potential gradient at the top of the tower attained 1,200 volts/meter and here the ratio E_+/E_- was found to be much above unity; in one case E_- was zero. Within the tower where the potential gradient was zero E_+ was approximately equal to E_-.—*J. S. D[ines]*.

OBSERVATIONS OF ATMOSPHERIC ELECTRICITY DURING THE TOTAL SOLAR ECLIPSE ON OCTOBER 10, 1912, AT BOÃ VISTA, BRAZIL.[6]

By W. KNOCHE and J. LAUB.

[*Reprinted from* Science Abstracts, Sect. A, July 30, 1917, § 663.]

Observations or records of the following were obtained for periods from October 2 to 11: Hertzian waves, radioactive content of air, fall of potential, conductivity (both + and −), positive and negative charge, number of ions (+ and −). Throughout the eclipse the sun was completely obscured by clouds, and the meteorological elements scarcely changed, so that it is supposed that the results obtained are independent of any indirect effect which might be produced by fluctuations of the meteorological elements.

The chief results produced by the eclipse were: The + and − charge, and the total number of ions showed a diminution followed by a recovery. The ratios of + to − charge, of + to − velocity of ions, and of + to − conductivity showed pronounced maxima, which occurred after the moment of totality. The + and − total conductivity and air-earth current showed minima shortly after the time of totality. (See Science Abstracts, 1917, No. 101).—*R. C[orless]*.

RELEASE OF RADIUM EMANATION FROM WATER AT DIFFERENT TEMPERATURES.[7]

By J. MORAN.

[*Reprinted from* Science Abstracts, Sect. A, July 30, 1917, § 645.]

This paper describes a study of the release of radium emanation from water by bubbling air through the radium solution at different temperatures, at a definite rate of flow of air. Observations were made with the temperatures of the solution at 16.5°, 20°, 30°, 60°, and 80°C., and the results show that the release of emanation is considerably increased as the temperature rises, naturally reaching an upper limit at 100°C.

It is proved that temperature is an important factor in the determination of RaEm by the bubbling method, and should be known and kept constant during an experiment.—*A. B. W[ood]*.

ABSORPTION BANDS OF ATMOSPHERIC OZONE IN THE SPECTRA OF SUN AND STARS.[8]

By Prof. A. FOWLER and Hon. A. J. STRUTT.

[Abstract of an address before the Royal Society, June 21, 1917.]

In this paper it is shown that a series of narrow bands in the ultra-violet absorption spectrum of ozone, appears in the spectra of the sun and stars near the extreme end of the photographic spectrum. The atmospheric origin of these bands is proved by the increase in their intensity in the solar spectrum as the sun's altitude is diminished. The observations are considered strongly to confirm the view of Hartley that ozone is the constituent of the atmosphere which limits the spectra of celestial bodies in the ultra-violet.

[4] Monthly Notices, Royal astron. society, March, 1917, 77:460-462.
[5] Terrestrial Magnetism, March, 1917, 22:35-37.
[6] Terrestrial Magnetism, Dec., 1916, 21:171-204.
[7] Trans., Roy. Soc. Canada, Sept., 1916, 10:57-64.
[8] *Reprinted from* Nature, London, July 5, 1917, 99:379.